Relate concentration to pH and conductivity

1) Justify the variation in the properties (pH and conductivity) for the four dilute aqueous solutions described in the table below.

	pH	**Conductivity**
HCl	1.0	high
NH_4Cl	5.1	high
NH_3	11.1	low
NaOH	13.0	high

2) Discuss the relative concentrations of the species present in each of the 0.100 mol L^{-1} solutions of NH_3 and HF. *You do not need to include water.* Include in your answer:

• any relevant equations

• a ranking of the species present in each solution in order of **decreasing** concentration

• justification for the ranking of the species.

No calculations are necessary.

3) Ethanoic acid, CH_3COOH, is a common organic acid.

$$pKa\ (CH_3COOH) = 4.76\ Ka = 1.74 \times 10^{-5}$$

Another organic acid is methanoic acid, HCOOH.

$$pKa\ (HCOOH) = 3.74$$

Account for the fact that 0.0500 mol L^{-1} methanoic acid has a lower pH than 0.0500 mol L^{-1} ethanoic acid.

4) Explain why aqueous aminomethane, CH_3NH_2, is a weak electrolyte.

5) An aqueous ammonia solution has a pH of 10 and when phenolphthalein indicator is added it turns pink. Solid ammonium chloride is added to this solution and the solution turns colourless due to a decrease in pH.

By considering the equilibrium systems, discuss why the pH of the solution decreased. **Include a relevant equation** in your answer.

6) Arrange the following 0.1 mol L–1 solutions in order of increasing pH.
NH_3
NH_4Cl
HCl
NaCl
NaOH
Give reasons for arranging in this order, including equations for any reactions occurring to produce solutions that **do not** have a pH of 7.

7) Comment on this statement:

8 mol L^{-1} hydrochloric acid is stronger than 0.2 mol L^{-1} hydrochloric acid.

8) pK_a : CH_3COOH = 4.75 and pK_a : CCl_3COOH = 0.70 Using these pK_a values, discuss the relative strengths of these acids.